VIBRATION TIME AND REST TIME DURING SINUSOIDAL VIBRATION EXPERIMENTS: DO THESE FACTORS AFFECT COMFORT RATINGS?

James P. Dickey[1], Michele L. Oliver[2], Natasha K. Lee Shee[1], Paul-Émile Boileau[3], Tammy R. Eger[4], Lana M. Trick[5], Vibration Research Group[6]

[1]Human Health and Nutr. Sci, University of Guelph, Guelph, Ontario, Canada
[2]School of Engineering, University of Guelph, Guelph, Ontario, Canada
[3] Institut de recherche Robert Sauvé en Santé et en Sécurité du Travail (IRSST), Montreal, Quebec, Canada
[4]School of Human Kinetics, Laurentian University, Sudbury, Ontario, Canada
[5]Department of Psychology, University of Guelph, Guelph, Ontario, Canada
[6](University of Guelph, Laurentian University, IRSST, University of Western Ontario, Mines and Aggregates Safety and Health Association, Ontario Forestry Safe Workplace Association and Construction Safety Association of Ontario).

Introduction

Industrial exposure to whole-body vibration is associated with injury and discomfort. Certain industries, notably mining, construction, and forestry, involve complex 6 degrees of freedom vibration. Laboratory-based studies of vibration are essential for controlled and systematic evaluation of the human responses to vibration[2]. The purpose of this pilot study was to evaluate whether the duration of the vibration exposure, and rest between vibrations, significantly influence the subjective ratings of comfort during laboratory-based studies of vibration.

Methods

Subjects: The cumulative vibration dose was calculated, and was below the health guidance caution zone recommended by International standards[3]. The experimental procedures were approved by the University of Guelph Research Ethics Board. Ten adult subjects participated in this pilot experiment. All subjects completed the entire experimental paradigm; no subjects complained of pain during or after the experiment.

Experimental Design: The experiment consisted of four blocks of vibration exposures; either 15 or 20 seconds of vibration (1 df:Z axis, 3 df:XY plane, 3df:YZ plane, or 6 df) alternating with either 5 or 10 seconds rest. The order of presentation of the four blocks was randomized. Each of the blocks was composed of 37 individual sinusoidal vibration exposures in randomized sequence. This abstract focused on ten identical trials, (6.3 Hz vertical vibration, 0.55 m/s^2 RMS) interspersed within each block, in order to assess whether the subjects' comfort ratings systematically varied between the 15 or 20 vibration exposures, the 5 or 10 second rest between vibrations, or within each block. The experiment involved 43 minutes of vibration within the 62 minute experiment.

Vibration Apparatus: A commercial parallel robotic platform was used to apply the specific vibration exposures (R2000, Parallel Robotics Systems Corporation, Hampton, New Hampshire). The subjects sat on a passenger seat from a 1992 Honda Accord that was rigidly mounted to the robotic platform (Figure 1). This robotic system performed the specific vibration exposures operating under closed-loop displacement control. A custom-written Matlab program automated the testing sequence.

Comfort Measures: Subjective feelings of comfort were verbally reported following each vibration exposure (during the rest period). The comfort scale was modelled after a previously published 9 point continuous comfort scale[1] which provided the greatest reliability and discrimination between different vibration intensities among 14 scales, but was modified to enable verbal reports (0 = "zero discomfort" & 8 = "max. discomfort").
Statistical Analysis: The raw comfort scale values for the ten identical vibration trials in each of the four blocks were analyzed using a three-way ANOVA.

Results

Figure 2 illustrates each of the subjects' comfort ratings for the ten repeated trials, collapsed across blocks of vibration duration. Statistical analysis did not observe significant interactions or main effects.

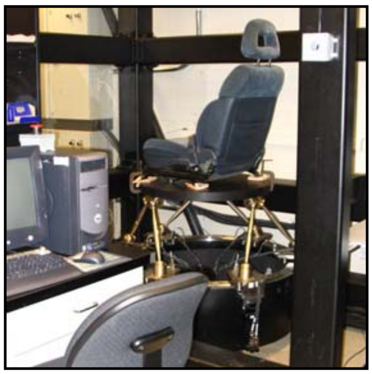

Figure 1. Photograph showing the seat mounted to the robot.

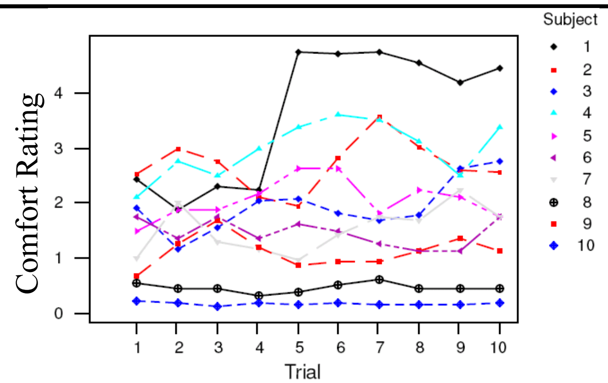

Figure 2. Comfort ratings for each of the subjects for the ten repeated trials.

Discussion

We did not observe statistically significant differences in comfort between the 15 or 20 second vibration exposures, or the 5 vs10 second rest durations. In addition, the comfort ratings did not vary systematically within the blocks of vibration. It appears that the one hour experiment duration did not result in systematic changes in reported comfort. This information is helpful for designing future laboratory-based vibration experiments.

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